UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/749,694	12/29/2003	Dimitry Gorinevsky	H0006745 US	2154

7590 02/22/2008

Kris T. Fredrick
Patent Srvices
Honeywell International Inc.
101 Columbia Road
Morristown, NJ 07962

EXAMINER	
BLOOM, NATHAN J	
ART UNIT	**PAPER NUMBER**
2624	
MAIL DATE	**DELIVERY MODE**
02/22/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/749,694	GORINEVSKY, DIMITRY
	Examiner	Art Unit
	Nathan Bloom	2624

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 January 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1, 7, and 14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "frame update rate" in claims 1, 7, and 14 is a relative term which renders the claim indefinite. The term "frame update rate" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The desired rate of update is not specified by the use of the term "frame update" and thus is being interpreted as any rate.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-2, 5-8, 12-15, and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biemond in further view of Owens ("Computer Vision on the MGAP"), and in further view of Lavenier ("Advanced Systolic Design").

Instant claim 1: A method of deblurring ~~an~~ a video image, comprising the steps of:

downloading a blurred video image comprising a plurality of ~~having~~ pixels into a systolic array processor, said systolic array processor comprising an array of processing logic blocks in parallel such that groups of said plurality of pixels arrive in each respective processing logic block of said array of processing logic blocks respectively ~~blocks;~~ [*Biemond describes an iterative method for image deblurring performed by a computing system used to process the image, but does not explicitly teach the downloading of a video image, the use of a systolic array processor to perform the deblurring method. Owens teaches the downloading of an image for further processing in paragraph 2 of the "Introduction" section. Owens further teaches the use of a systolic array of interconnected logic blocks (Digit Processors) for the parallel processing of images (deblurring is image processing) in sections 2.1 and 3.1. Furthermore, figure 4 of Owens shows the adjacent interconnections of the processing array in which the plurality of pixels are communicated to their respective Digit Processors (processing logic blocks).*
It would have been obvious to one of ordinary skill in the art at the time of the invention to use the known systolic array disclosed by Owens with the known iterative image deblurring method disclosed by Biemond according to Lavenier that teaches the use of iterative methods on systolic array (section 5.2). Therefore, the combination provides the predictable result of iterative image deblurring according to the known method of Biemond using the known device of a systolic array as disclosed by Owens and Lavenier. Also, neither Owens, nor Lavenier, nor Biemond discuss the processing of video images. However, a video is a series of frames (images) and a method such as is taught by Biemond that operates on a single image can clearly be used to

operate on a plurality of images sequentially. Thus the method taught by Biemond in view of Owens and Lavenier for deblurring an image can also be used on a sequence of images (video).]

sequentially exchanging data between said array of processing logic blocks by interconnecting each processing logic block with only a predefined number of the processing logic blocks adjacent thereto; ~~and~~ [*This is the definition of array processing, which is the processing and communication of data by a grid of processing units that are interconnected with adjacent processing units. For an example see figure 4 of Owens.*]

providing an iterative update of said blurred video image by storing each pixel of said plurality of pixels in three planes within said systolic array processor wherein said iterative update occurs within a video frame update rate of said blurred video image: and [*Biemond teaches the iterative deblurring method in the section entitled "Iterative Solutions" beginning on page 865 using three sets of data (f_{k+1}, f_k, and $g-Hf_k$) each dependent on the particular pixel data they correspond to (thus each set is an image "plane" because it varies with x and y, where x and y are the pixel indices). Furthermore, the video frame update rate is not defined within the language of the claim as indicated by the 35 USC 112 2nd paragraph rejections given above and thus is interpreted as being any reasonable rate. The method and system disclosed by Biemond in view of Owens and Lavenier has some rate at which it accomplishes the image deblurring and thus meets the limitations of this claim language.*]

uploading ~~the~~ a deblurred video image [*Owens and Biemond do not explicitly teach the uploading of the blurred image. Examiner takes official notice that the uploading of the deblurred (processed) image is notoriously well known in the art. Since the purpose of deblurring the image is to produce a deblurred image for display or further processing, and thus*

would have been obvious to one of ordinary skill in the art to store or upload the processed image for retrieval or display.].

Instant claim 2: The method of claim 1, wherein said three planes comprises said blurred video image, a blurred video image prediction error, and a past deblurred video image, wherein said array of processing logic blocks provide ~~providing an~~ said iterative update of said blurred video image by (i) providing feedback of said ~~the~~ blurred image prediction error using said ~~the~~ deblurred video image and (ii) providing feedback of said ~~the~~ past deblurred image estimate [*Owens and Lavenier disclose the implementation of a iterative method on a systolic array as is discussed in rejection of instant claim 1. Biemond teaches an iterative method for deblurring images in pages 865-868 under the section titled "C. Iterative Solutions" using error feedback and past deblurred image estimate feedback (f_k, and g-Hf_k). In particular, see equations 56 and 57 on page 865. Furthermore, as is evidenced by both Lavenier in section 5.2the implementation of iterative algorithms on a processing array was well known to one of ordinary skill in the art.*]

Instant claim 5: The method of claim 1, wherein said each group of said groups of said plurality of pixels processor groups pixel in groups that comprises at least one pixel. [*Biemond in view of Owens and Lavenier as applied to claim 1 teach the deblurring of an image using a systolic processor array. Owens teaches the implementation of image processing methods using systolic array processors for image processing and in the final line of the 2nd paragraph on page 338 that at a least one pixel is operated on per processor. Thus, as is taught by Owens the pixels are grouped into groups of pixels such that at least one pixel is operated on per processor.*]

Instant claim 6: The method of claim 5, wherein said groups of pixels comprises a group selected from 2 by 2 pixels, 3 by 3 pixels, and 4 by 4 pixels. [*Filtering and image processing methods such as deblurring are done locally by operating on groups of adjacent pixels. Owens discloses an example of such a grouping in section 3.1 on page 338 wherein Owens disclosed the use of 3x3 masks applied to the image and hence it was known to group and process pixels in a processing array.*]

Instant claims 7-8, 12-13, 14-15, and 19-20 claim the corresponding device that performs the method of instant claims 1-2 and 5-6. As per rejection of instant claims 1-2 and 5-6 the method and has been disclosed by Biemond in view of Owens and Lavenier. Furthermore, the device has been disclosed since Owens and Lavenier have disclosed the implementation of such methods on a systolic array device.

5. Claims 3, 9-10, and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biemond in view of Owens and Lavenier as applied to claims 1-2 and 5 above, and in further view of Gorinevsky ("Optimization-based Tuning of Low-bandwidth Control in Spatially Distributed Systems").

Instant claim 3: The method of claim 2, wherein said iterative update is implemented in said <u>each</u> processing logic <u>block</u> ~~blocks~~ by $u(n+1) \equiv u(n) - K * \left(H * u(n) - y_b\right) - S * u(n)$ [*Biemond:*

see equations 56 and 57 on page 865, u(n+1)=f(k+1), u(n)=f(k), g= y_b *, K=B, and H=H*] where u comprises an ~~is the~~ ideal undistorted image, m and n comprise ~~are~~ column and row indices of an image pixel element, $y_b(m,n)$ comprises an ~~is the~~ observed blurred image, * denotes a 2-D convolution, K comprises ~~is~~ a feedback update operator with a convolution kernel k(m,n) and S comprises ~~is~~ a smoothing operator with a convolution kernel s(m,n) [*Biemond identifies the existence of regularization error and discloses a solution of the regularization error in section 5 which begins on page 868. The term* $S * u(n)$ *as defined by applicant was known to one of ordinary skill in the art as a solution to the regularization problem. Biemond does not teach the regularization method shown by applicant. However, Gorinevsky in sections 1 and 3 teaches a filter that improves the spatial response (reduces regularization error) of the system. It would have been obvious to one of ordinary skill in the art to substitute the regularization method as taught by Gorinevsky for the regularization method taught by Biemond with a reasonable expectation of success while maintaining or improving the spatial response (reduction of regularization error) provided by the method taught by Biemond. Furthermore, in the same sections of Gorinevsky the use of the term K has also been disclosed.*].

Instant claims 9 and 16 claim the corresponding device that performs the method of instant claim 3. As per rejection of instant claims 1-3 the method and has been disclosed by Biemond in view of Owens, Lavenier, and Gorinevsky. Furthermore, the device has been disclosed since Owens and Lavenier have disclosed the implementation of such methods on a systolic array device.

Instant claims 10 and 17: The device of claim 9 [*and 16*], wherein the operators H, K, and S are preloaded in each of the array processing logic blocks. [*Owens and Lavenier do not explicitly teach the preloading of the information into each processing logic block of the array. However, as is evidenced by Owens in the 2nd paragraph of page 338 the addition, subtraction, multiplication,..., etc. are preformed on the received pixel data. In order to perform these operations the values intended to be used in these operations must be stored in the processing elements. Furthermore, as per the disclosure of Lavenier in section 5.2 the weights of matrix W are stored in the processing units so that they can be used to multiply the values of the input (X). Thus it is clear from this disclosure that known constants are stored in the processing units (logic blocks) in order to perform the predetermined operations.*]

6. Claims 4, 11, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biemond in view of Owens, Lavenier, and Gorinevsky as applied to claims 3, 9-10, and 16-17 in further view of Dowski (US 2003/0169944).

The method of instant claim 4 is a modification of the method of instant claim 3 wherein the deblurring is performed on each color space separately. Biemond discusses image processing, but do not go into the particulars of color space processing. However, as is evidenced by Dowski in paragraph 0018 the method of dividing an image into its color spaces and then deblurring each of the color spaces was known to one of ordinary skill in the art. Furthermore, the teaching of Dowski shows that one of ordinary skill in the art knew how to apply image-filtering processes such as deblurring to each color channel. Given that Biemond teaches the deblurring of at least a grayscale image and that Dowski teaches the application of a single

channel deblurring process to each of the color channels. It would have been obvious to one of ordinary skill in the art to combine the teachings of Dowski with Biemond to perform the deblurring technique as taught by Biemond on each channel of a color image (as taught by Dowski) and yield the expected result of a deblurred color image.

Instant claims 11 and 18 claim the corresponding device that performs the method of instant claim 4. As per rejection of instant claims 1-4 the method and has been disclosed by Biemond in view of Owens, Lavenier, Gorinevsky, and Dowski. Furthermore, the device has been disclosed since Owens and Lavenier have disclosed the implementation of such methods on a systolic array device.

7. Applicant's arguments with respect to claim 1-20 have been considered but are moot in view of the new ground(s) of rejection.

Furthermore, applicant argued that the motivations disclosed above did not meet the TSM requirements. In regards to this Examiner would like to point out that the TSM test is not the only test for obvious as is shown by the KSR rulings. Please see below for a brief description of these requirements.

The Supreme Court held that in analyzing the obviousness of combining elements, a court need not find specific teachings, but rather may consider "the background knowledge possessed by a person having ordinary skill in the art" and "the inferences and creative steps that a person of ordinary skill in the art would employ." *See KSR Int'l v. Teleflex Inc.*, 127 S. Ct.

1727, 1740-41, 82 USPQ2d 1385, 1396 (2007). To be non-obvious, an improvement must be "more than the predictable use of prior art elements according to their established functions." *Id.*

Based on this and the combinations proposed in the discussion above the predictable result of combining an iterative image deblurring method according to the known method of Biemond using the known device of a systolic array disclosed by Owens using the implementation of iterative methods on a systolic array as described by Lavenier is the iterative deblurring of an image on a systolic array. Furthermore, it was well established in the art as is evidenced by Owens to speed up image processing methods by implementing them on a systolic array.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- Rao and Kailath, "Regular Iterative Algorithms and Their Implementation on Processor Arrays" - implementation of iterative algorithms using array processors.
- Moon et. al., "Fast Iterative Image Restoration Algorithms" – iterative image algorithm, discusses number of iterations necessary.
- Wu et. al., "Fast Image Restoration in Large Digital Photos" - iterative image algorithm, discusses the number of iterations necessary.
- Fimmel and Merker, "Design of Processor Arrays for Real-Time Applications" – array processing used for real-time processing.

- Hui and Er, "Fast Iterative Algorithm for Real-Time Array Processing" – the use of iterative algorithms for real-time array processing.
- Ogrenci et. al., "Image Analysis and Partitioning for FPGA Implementation of Image Restoration" - image processing using array processing.
- Ogrenci et. al., "Analysis and FPGA Implementation of Image Restoration under Resource Constraints" – image processing using array processing.
- Kang and Katsaggelos, "Simultaneous Iterative Image Restoration and Evaluation of the Regularization Parameter" – iterative image processing algorithms.
- Katsaggelos et. al., "A Regularized Iterative Image Restoration Algorithm" – image deblurring algorithm.
- Katsaggelos et. al., "Parallel Processing Architectures for Iterative Image Restoration" – iterative image deblurring using array processing.
- Paik and Katsaggelos, "Parallel Iterative Image Restoration Algorithms" - iterative image deblurring using array processing.
- Swaiij et. al.,"Synthesis of ASIC Regular Arrays for Real-Time Image Processing Systems" – real-time image processing using array processing.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nathan Bloom whose telephone number is 571-272-9321. The examiner can normally be reached on Monday through Friday from 8:30 am to 5:00 pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jingge Wu, can be reached on 571-272-7429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

01/09/2007

Nathan Bloom

SAMIR AHMED
SUPERVISORY PATENT EXAMINER